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DIST. CR REGION

W.P. No. 271-87-00

CONT. No. 95-34

W. O. No.

STR. SITE No.

HWY. No. 401

LOCATION Pond # 6, South Side
of 401, E of Whites Rd.

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



TORONTO AREA (416) 798-4912
HAMILTON AREA (905) 523-5825
FAX (905) 842-9278

project supervisor

JONATHAN MILLS
PROJECT ENGINEER

*Ray
Hotman*

*SITE 416-281-2309
(M) 416-540-9595 office*

DUFFERIN CONSTRUCTION COMPANY
690 Darnall Drive, Suite 200, Oakville, Ont. L6K 3W7 *416 283-6308*

Ron Holman
Project Supervisor
Central Region Construction

Ministry of Transportation
Central Region Construction Office
Atrium Tower, 2nd Floor
1201 Wilson Ave
Downsview ON M3M 1J8
Tel: (416) 283-6308
Fax: (416) 283-6850
Mobile: (416) 402-0677



m e m o r a n d u m



To: P. Chackeris
Sr. Project Engineer
Freeway Engineering

December 21, 1995

From: Pavements and Foundations Section
Room 315, Central Building

Phone: 235-3731

Re: Hwy 401 EB Collectors and Express Rehabilitation - CNR Subway to Westney Road
Detention Pond 6 WP 274-87-00, Central Region

The design of the detention pond proposed south of the Highway 401 widening at the CNR Subway has been changed from a wet pond to a dry pond resulting in a higher base elevation and a 2H:1V slope configuration. It was requested that foundation recommendations be provided based on the most recent pond geometry. The following comments and recommendations apply in conjunction with the surficial stability and construction considerations outlined in our memo dated 95 09 28.

A great deal of effort has been put into analysing and developing the recommendations for Pond 6 slope stability. Regardless of pond type, the addition of a detention pond at the base of the existing GO embankments results in embankments as high as 11 m. Although, the existing slopes are stable for heights of 9.0 m or less, a 2.0 m wide mid-height berm is recommended for embankments exceeding 9.0 m for reasons of safety, stability and maintenance.

Where space restrictions are realized, the alternatives proposed by T. Sangiuliano in his memo dated 95 11 09, appended, are valid. These include the incorporation of a reinforced or conventional retaining wall or a 1H:1V reinforced slope.

If there are any questions regarding the above, please advise.

A handwritten signature in black ink, appearing to read "Betty Bennett".

Betty Bennett, P.Eng.
Foundation Engineer

cc: R. Hassall, Delcan

MEMORANDUM



To: P. Chackeris
Senior Project Engineer
Freeway Engineering

Date: 1995 11 09

From: Pavements and Foundations Section
Room 315, Central Bldg.

Tel: 235-3731

Fax: 235-5240

Re: Contract 95-34, W.P. 271-87-00
Hwy 401 Eastbound Collectors and Express Rehabilitation
Hwy 2 to East of Whites Road
Detention Pond 6
Pickering, Central Region

As requested in your memorandum dated November 1, 1995, our office has completed an analysis of the proposed Hwy 401 Eastbound Collector embankment that is to be constructed adjacent to the proposed detention pond #6. A summary of the results of stability analysis conducted and recommendations are summarized below.

ANALYSES

General - Slope Stability

The critical condition examined in the global stability of an excavation cut located at the toe of an embankment fill slope is the long term (drained) condition. Consequently an effective stress analysis was conducted for the proposed embankment at the site. In all cases global stability computations were carried out using a commercially available slope application software package called G-slope.

The subsurface conditions and subsoil parameters used in the previous railroad embankment analyses were applied to this subsequent set of analyses. A top of embankment elevation of 85.5m and a groundwater level elevation of 78m were used. A unit weight(γ) of 20 kN/m³ and angle of internal friction(ϕ) of 30° were used for the Fill material parameters.

Different slope geometries were analyzed in an attempt to achieve an acceptable factor of safety of 1.3. Geogrid reinforced earth embankments that enable slopes as steep as 1H:1V were examined. Although global stability analyses were completed, the internal and global stability will have to be coordinated between the supplier of the reinforced earth system and our office.

Both surficial and global slope stability concerns have been addressed in our review of the proposed Hwy 401 embankment.

General - Retaining Wall

As an alternative to the embankment slope geometry, consideration can also be given to employing

a mechanically stabilized earth (MSE) retaining wall or a conventional cantilever retaining wall. Global stability analyses were conducted to evaluate the overall stability of a retaining wall. The internal stability of the MSE wall will have to be undertaken by the supplier of the proprietary wall and coordinated with the global stability analyses.

RESULTS

SLOPE STABILITY

1H:1V Slope Geometry

Global Stability

Stability analyses for an overall 1H:1V slope geometry were based on employing a geogrid reinforced embankment fill slope and advancing an excavation cut at 1H:1V within the native soil. The results of the analyses reveal that a global safety factor of 1.3 can be achieved by increasing the reinforced soil zone. However, surficial instabilities can occur with 1H:1V slopes as mentioned below.

Surficial Stability

Surficial stability problems for 1H:1V slopes either with conventional vegetative cover or using a rockfill material with a granular filter are anticipated.

1H:1V Embankment Fill Slope and 2H:1V Excavation Cut Slope

Global Stability

Stability analyses for a 1H:1V fill slope geometry is based on employing a geogrid reinforced embankment. The results of the analyses reveal that a safety factor of 1.3 can be achieved by increasing the reinforced soil zone. For estimate purposes, the length of the reinforced earth zone must be at least equal to the embankment height.

Surficial Stability

No stability problems are anticipated employing conventional slope vegetation on 2H:1V slopes.

2H:1V Embankment Fill Slope and 2H:1V Excavation Cut Slope

Global Stability

Stability analyses for an overall 2H:1V slope geometry revealed an acceptable safety factor of 1.3.

Surficial Stability

No stability problems are anticipated employing conventional slope vegetation on 2H:1V slopes.

RETAINING WALL

Global Stability

MSE Wall

Stability analyses for a retained soil system approximately 4.5 metres in height with an excavation cut slope of 2H:1V were conducted. Based on the analyses, global stability concerns can be satisfied provided a reinforced soil zone of sufficient length is provided. The internal and global stability design of the retaining wall will have to be coordinated between the supplier and our office. For estimate purposes, a minimum reinforced soil zone equivalent to the height of the wall can be used.

Conventional Retaining Wall

It is recommended that the conventional retaining wall be founded on spread footings stepped at an Elevation 76.5m to 77.5m(east to west). There are no global stability problems anticipated.

Surificial Stability

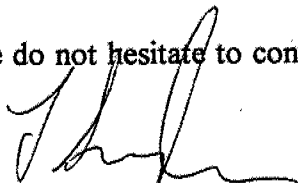
No stability problems are anticipated employing conventional slope vegetation on 2H:1V slopes.

RECOMMENDATIONS

Based on our review and stability analyses conducted, it is recommended that the Hwy 401 embankment and the excavation cut be designed and constructed using one of the three options given below. The option which is the most cost effective and viable at the site should be chosen.

1. Geogrid Reinforced Embankment at 1H:1V and 2H:1V Excavation Cut provided that a reinforced soil zone of sufficient length is provided.
2. Mechanically Stabilized Earth or Conventional Retaining Wall with a 2H:1V Excavation Cut slope
3. 2H:1V Conventional Embankment Fill and 2H:1V Excavation Cut

If you have any questions regarding the above comments, please do not hesitate to contact this office.



T. Sangiuliano, P. Eng.
Foundation Engineer
for

D. Dundas, P. Eng.
Senior Foundation Engineer

MEMORANDUM

Freeway Engineering
5th Floor Atrium Tower
Central Region

Telephone: 235-5567



To: T. Sangioulino, Foundations Section

November 1, 1995



Re: Contract #95-34, W.P. 271-87-00, Highway 401 Collector
Widening and Express Rehabilitation, Scarborough &
Pickering, Central Region.

As discussed in a meeting with GO Transit on October 27, 1995, please review the proposed configuration for the revised Pond #6 as detailed in the attachment from Delcan.

The problem of surficial and sub-surface stability should be addressed for the scheme presented. As discussed Delcan has reviewed a second scheme that provides for a 2:1 slope within the front slope. This was found to be unpractical, since only a very small area at 2:1 could be provided. Any new methods to stabilize the surface of the slope should be entertained.

Please provide your comments on this proposal by November 14, 1995.

A handwritten signature in black ink, appearing to read "P. Chackeris".

P. Chackeris, P.Eng.
Senior Project Engineer

cc: R. Hassall, Delcan

MEMORANDUM



To: D. Billings
Head, Geotechnical Section
Central Region

September 28, 1995

Atten: David Grimmond

From: Pavements & Foundations Section
Room 315, Central Building

Tel: 235-3731
Fax: 235-5240

Re: Contract 95-34, W.P. 271-87-00, Geocres # 30M14-234
Hwy. 401 Eastbound Collectors and Express Rehabilitation
Hwy. 2 to East of Whites Road
Detention Pond 6
District 6, Toronto

Further to your request, this memorandum summarizes the results of a foundation investigation conducted in conjunction with a storm quality pond proposed to be constructed between 29 + 507 and 29 + 625. As indicated in your memorandum dated 1995 07 27, the request was initiated as a result of the identification that the proposed location of the pond shown on Sheet 93 of the contract drawings conflicted with the north side slope of the existing GO train embankment. The existing embankment is in the order of 9 metres in height and the proposed pond is in order of 1.5 to 3.5 metres in depth.

This memorandum contains recommendations for an appropriate slope geometry to prevent any slope instabilities at the site.

SITE DESCRIPTION

The site is located immediately south of the Hwy. 401 EB collector lanes that were under construction at the time of the foundation investigation between Whites Rd. and the CNR-Hwy. 401 subway. Embankment fill for the Hwy. 401 EB collector lane was being placed and compacted during the investigation.

The existing GO train embankment is approximately 9 metres in height and at a 2H:1V slope geometry. The slope is covered with grass for most of the embankment except between the limits of the proposed pond where the surficial grass was excavated within the lower half of the slope. Railroad tracks at the crest of the slope are supported by timber and rock ballast.

INVESTIGATION PROCEDURE

Physical and mechanical soil properties were obtained by in-situ and laboratory testing. The fieldwork for the investigation was carried out on August 21, 1995 and consisted of (3) sampled boreholes advanced to depths ranging between 7.8 and 9.3 m below the existing ground surface at the toe of the existing embankment. A track mounted drilling unit was used to advance the boreholes employing conventional hollow stem augering techniques.

Disturbed subsoil samples were generally retrieved at 0.76 m for the surficial 3 to 4.5 metres and at 1.5 m intervals thereafter employing a standard split spoon sampler in accordance with the Standard Penetration Test (ASTM D1585). All subsoil samples were identified in the field and then placed in sealed plastic jars to ensure the preservation of the natural moisture contents.

Groundwater levels were determined by monitoring the levels in the open boreholes. All boreholes were backfilled upon completion of the fieldwork.

All samples were transported to the laboratory where visual examinations were conducted using procedures described in the MTO Soil Classification Manual. Laboratory tests were carried out on selected representative samples to define the behaviour, gradation and other physical properties of the soil. These tests include Atterberg Limits, grain size distribution, natural moisture contents and bulk unit weights.

In-situ and laboratory test results are illustrated on the corresponding boreholes and figures included in the Appendix of this report. A description of the subsurface conditions and the test results are given below.

SUBSURFACE CONDITIONS

General

The ground surface at the toe of the existing embankment slopes gently downward westerly with surface elevations varying from 81.4 m to 79.3 m. The subsurface conditions at the site are generally uniform and consist of a surficial deposit of a cohesive heterogeneous mixture of a brown clayey silt, sand and gravel. This deposit is a glacial till and has a thickness ranging from 1.5 m to 2.6 m. The cohesive heterogeneous mixture of clayey silt, sand and gravel is underlain by a second glacial till deposit consisting of a grey cohesionless heterogeneous mixture of silt, sand and gravel. This deposit has a thickness ranging from 5.1 m to 6.8 metres.

The cohesionless heterogeneous mixture of silt, sand and gravel is underlain by shale bedrock. The elevation of the shale bedrock varies from approximately 72.3 m to 71.6 m in a west-east direction. The shale bedrock is grey-black in colour, weathered and very weak to weak.

Although not encountered, boulders and cobbles are characteristic components of glacial till deposits and hence can exist in either glacial deposit.

The boundaries between the various soil types, insitu and laboratory results as well as groundwater levels established at the time of the investigation are shown on the attached Record of Borehole

sheets in the Appendix. A subsoil stratigraphical section is provided on Drawing 9534-A also included in the Appendix.

Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)

The surficial native material at the site location consists of a deposit comprised of a cohesive heterogeneous mixture of clayey silt, sand and gravel. The deposit also contains random interbedded seams of sand of thickness up to approximately 50 mm..

The main component of this unsorted, unstratified deposit is the clayey silt material. This material essentially bind the coarser sands and gravels within the deposit.

Grain size distribution curves for this deposit as determined by mechanical sieve and hydrometer analyses is given in Figure 1. The fine grained portion (less than 75 micrometers) contribute approximately 62 to 63% of the deposit with sand percentages equivalent to 32 to 33% and gravel percentages equivalent to 4%.

Atterberg Limit tests carried out to determine the behaviour and plasticity of the fine grained portion of the soil revealed liquid limits and plasticity indexes ranging from 20 to 22% and 8 to 9% respectively as shown on Figure 2. Based on these results, the fine grained portion of the deposit is categorized as a clayey silt.

The consistency of this deposit is stiff to very stiff with Standard Penetration Test (SPT) 'N' values ranging from 10 blows/0.3 m to 23 blows/0.3 m.

Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till)

The cohesionless heterogeneous mixture of silt, sand and gravel underlies the cohesive heterogeneous mixture of clayey, silt, sand and gravel at a depth of 1.5 m to 2.6 m below the ground surface (elevation 79.1 m to 76.7 m).

A grain size distribution envelope shown on Figure 3 illustrate clay and silt percentages ranging from 41% to 47% and sand percentages ranging from 46% to 54%. Clay fractions are typically less than 10%.

The upper 1.5 metre or so of the deposit is generally of a compact state of denseness with SPT 'N' values generally ranging from 13 blows/0.3 m to 19 blows/0.3 m. Beneath this upper zone, the deposit becomes dense to very dense with SPT 'N' values typically exceeding 50 blows/0.3 m and as high as 50 blows/0.08 m.

Groundwater Conditions

Observation of the groundwater level was carried out by measuring the water level in the open boreholes. Groundwater levels ranged from approximately 2.7 to 3 m below the ground surface at the time of the investigation (Elevation 78.7 m to 76.3 m).

Groundwater levels, in general, are subject to seasonal fluctuations and hence can vary from the values given in this report.

DISCUSSION AND RECOMMENDATIONS

A stormwater quality pond identified as pond #6 was planned to regulate stormwater discharges from the Hwy. 401 EB collectors between Stations 29 + 507 and 29 + 625 as shown on sheet 93 of the contract drawings. The bottom of the pond is 2 metres in width and at elevation 78 metres. The ground surface elevation at the toe of the existing GO train embankment ranges from approximately 81.5 m to 79.5. Consequently, the pond depth ranges from 1.5 metres to 3.5 metres in depth.

As mentioned previously, an embankment up to 9 metres in height exists at the southern limit of the site. During construction, it was identified that the planned layout of the pond conflicted with the side slope of the embankment. To avoid potential embankment instabilities, our office was contacted to provide recommendations for a safe slope geometry that would enable the construction of pond #6. The problem was one of slope stability and hence slope stability analyses were carried out as described below.

SLOPE STABILITY

General

The critical condition examined in the evaluation of an excavation cut at the toe of an embankment fill slope such as proposed at the site location is the long term (drained) condition and consequently an effective stress analysis was conducted. In all cases, global stability computations were carried out using a commercially available slope application software package called G-slope. The G-slope stability analyses is based on Bishop's method of slices. Circular slip surfaces were evaluated and a critical slip surface was searched.

The process of stability analyses involves the selection of pertinent shear strength parameters and physical soil properties such as unit weight, inputting the subsurface and groundwater conditions and then designing a surface geometry that produces an acceptable factor of safety of 1.3 using the G-slope program.

External loadings such as the railroad loading at the crest of the existing embankment must also be considered.

Figure 4 in the Appendix illustrates the subsurface conditions, groundwater conditions, slope geometry, external railroad loading and subsoil parameters used in the stability analyses. A railroad line load of 120 kN/m was used in the analyses. The results of the global stability analyses are summarized below.

Global Stability

Option 1

Figure 4 illustrates the slope geometry required to achieve global stability. Based on the analyses, the pond must be offset with a 6 metre bench from the toe of the existing embankment.

A 6 metre bench design does not appear possible at the site. To reduce the bench width, consideration can be given to employing geomembrane or geosynthetic clay liners as described in Option 2 below.

Option 2

The results of the analyses illustrated in Figure 4 are based on the groundwater table located at the level of the original ground surface to account for potential water infiltration into the native soil during flood conditions. At the time of the investigation, groundwater levels ranged from 2.7 m to 3 m below the ground surface. To reduce the magnitude of the bench offset requirement from 6 metres which appears to be impractical at the site, to 2 metres as shown on Figure 5 consideration can be given to lining the pond base and slopes with a geomembrane or a geosynthetic clay liner. Geomembranes or geosynthetic clay liners provide impervious boundaries, hence preventing a rise in the groundwater table in addition to serving as a control for settling solids and any associated pollutants needed for storm water quality control. Material and installation specifications and costs can be obtained from our office.

Surficial Stability

Excavation of the cohesive heterogeneous mixture of clayey silt, sand and gravel and also the cohesionless heterogeneous mixture of silt, sand and gravel is necessary to facilitate the construction of the pond. An erosion protection scheme will be required to protect these soils from the erosional forces of the impounding water.

For option 1, it is recommended that 300 mm rip rap or rock protection as specified in OPSS 1004.05.06 be employed. In addition, it is recommended that a filter material be placed between the native soil and the outer rock shell to prevent soil migration which can result from unbalanced hydrostatic head conditions caused by the cohesionless heterogeneous mixture of silt, sand and gravel submerged below the groundwater table. A 0.6 m thick granular 'A' material is considered as a suitable filter/drainage medium to control soil migration and sloughing of the fine grained material below the groundwater table.

The slope protection should be placed a minimum 0.5 m above the high water level. Normal slope vegetation cover as per MTO standards shall be established above the high water level.

For option 2, the geomembrane or geosynthetic clay liner serves as an erosional protection and revetment system. Normal slope vegetation shall still be applied on the surface of the geomembrane or geosynthetic clay liner.

CONSTRUCTION CONSIDERATIONS

Dewatering

A dewatering scheme will be required to facilitate the excavation of the cohesionless heterogeneous mixture of silt, sand and gravel submerged below the groundwater table. An NSSP should be included in the contract documents that alerts the Contractor that the heterogeneous mixture of silt, sand and gravel submerged below the groundwater table is subjected to conditions of unbalanced head and hence can slough or cave into the excavation.

The Contractor is responsible for ensuring that the excavation is carried out in a safe manner without causing surficial slope instabilities. One dewatering scheme that could be considered is to excavate a pilot trench within the centre of the pond excavation and then allowing excavation to proceed laterally to the limits of the excavation. This pilot trench not only allows for drainage to occur, which can be discharged using conventional pumping equipment and techniques, but any soil sloughing can be controlled within the centre of the excavation. Perimeter ditches can also be constructed to facilitate the dewatering and excavation.


Temporary Slopes

Temporary slopes within the native heterogeneous mixture of clayey silt, sand and gravel and the heterogeneous mixture of silt, sand and gravel shall not be steeper than 1H:1V.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of T. Sangiuliano, Foundation Engineer and Deanna Brooker, Student Engineer, utilizing equipment owned and operated by DSIL Drilling Ltd. The project was carried out by T. Sangiuliano under the general supervision of D. Dundas, Senior Foundation Engineer.

If you have any question regarding this memorandum or require additional information please do not hesitate to contact this office.



T. Sangiuliano, P. Eng.
Foundation Engineer

for

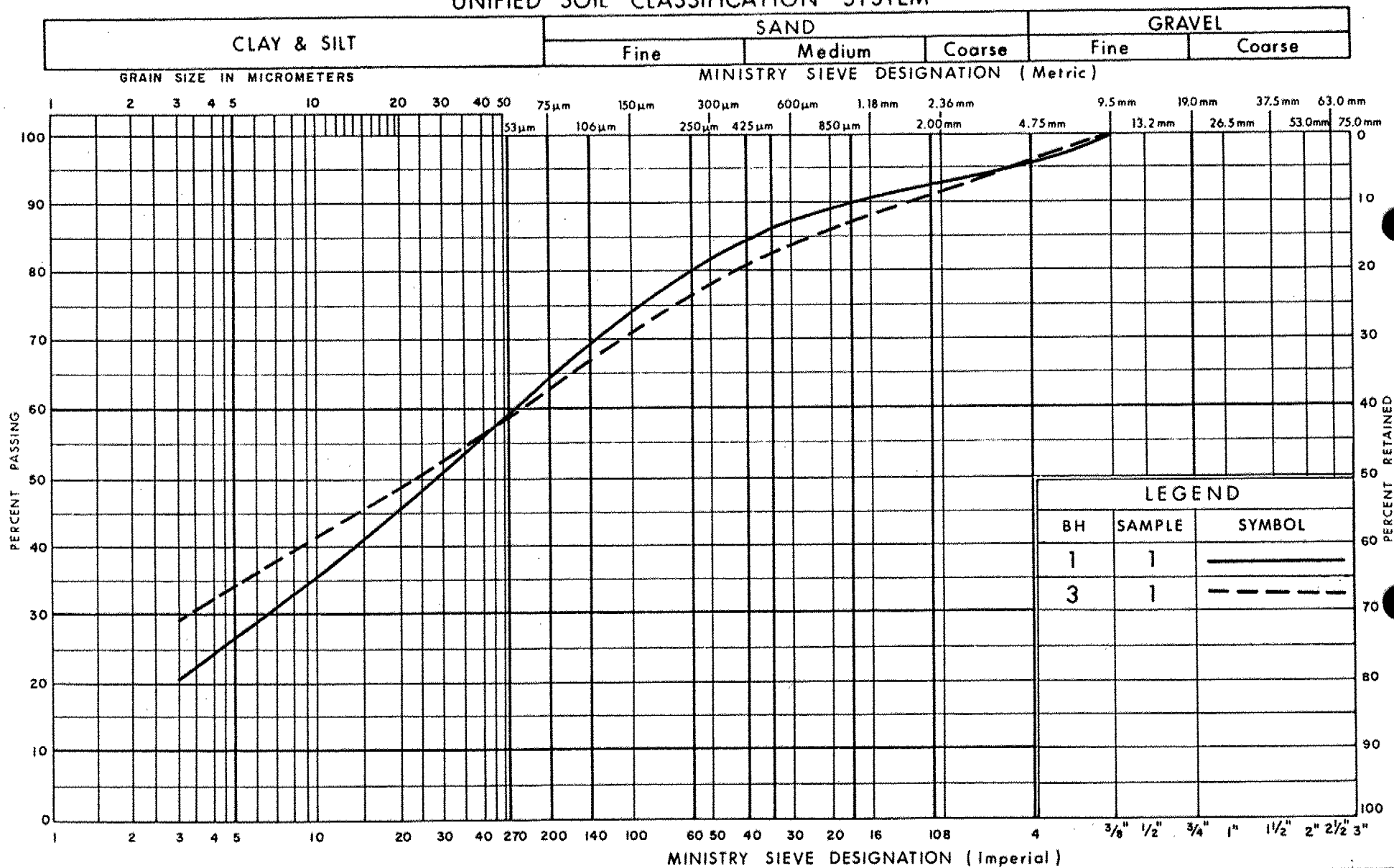
D. Dundas, P. Eng.
Sr. Foundation Engineer

TS/mmj

c.c. - P. Chackeris

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

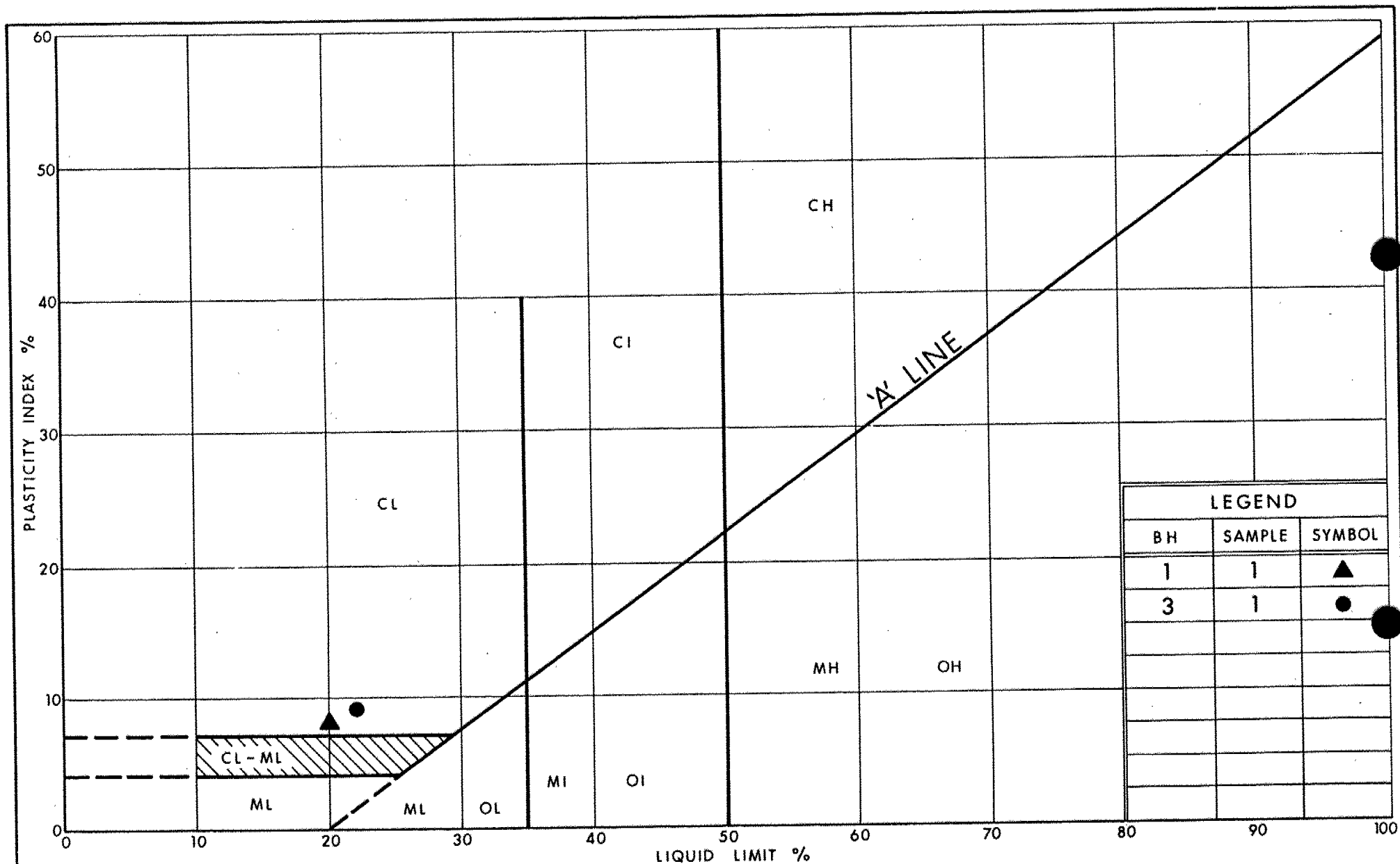
HET MIXTURE OF

CLAYEY SILT, SAND & GRAVEL (Glacial Till)

FIG No 1

W P 271-87-00

CONT 95-34



Ministry of
Transportation
Ontario

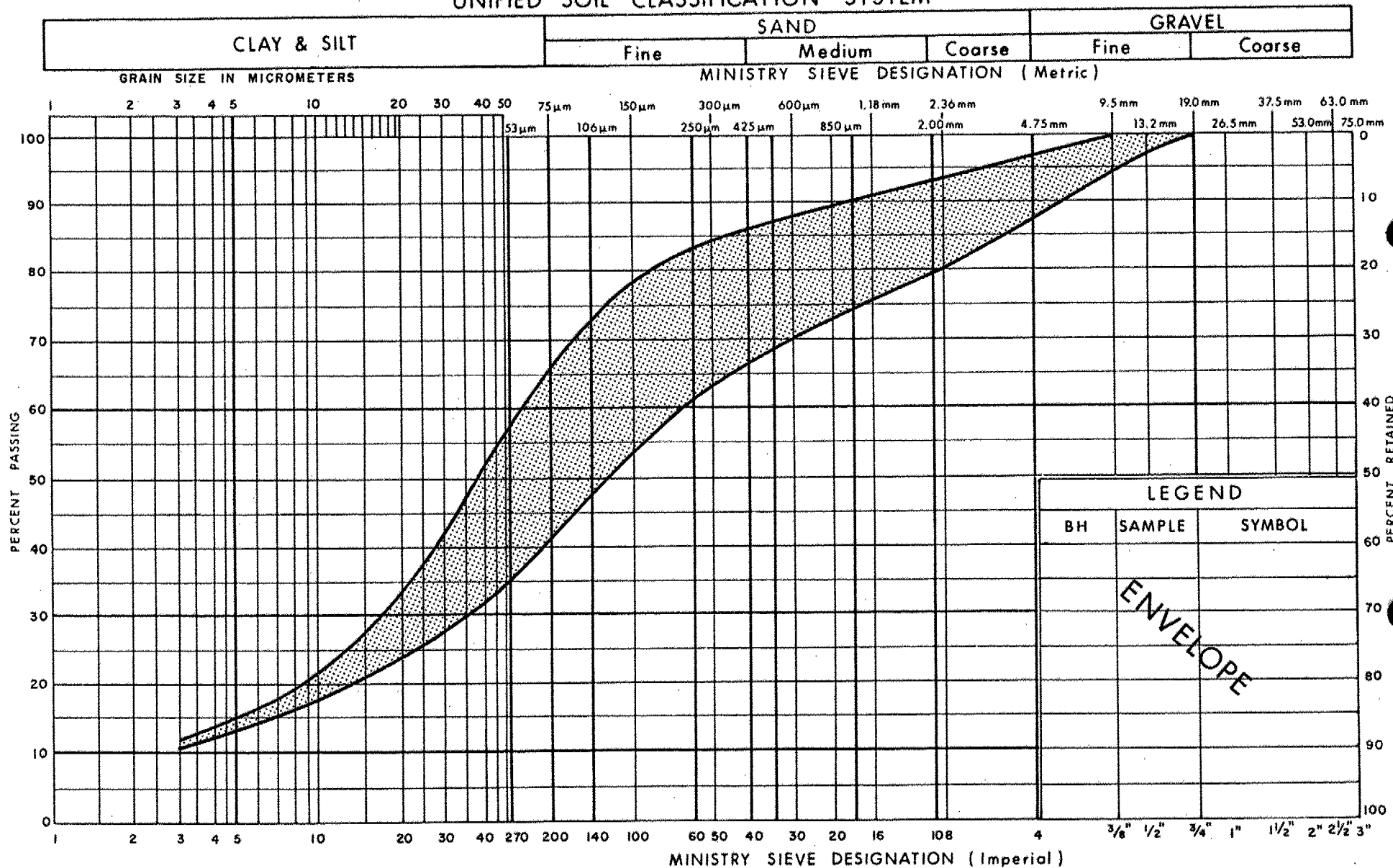
PLASTICITY CHART HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL (Glacial Till)

FIG No 2

W P 271-87-00

CONT 95-34

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
HET MIXTURE OF
SILT, SAND & GRAVEL (Glacial Till)

FIG No 3

W P 271-87-00

CONT 95-34

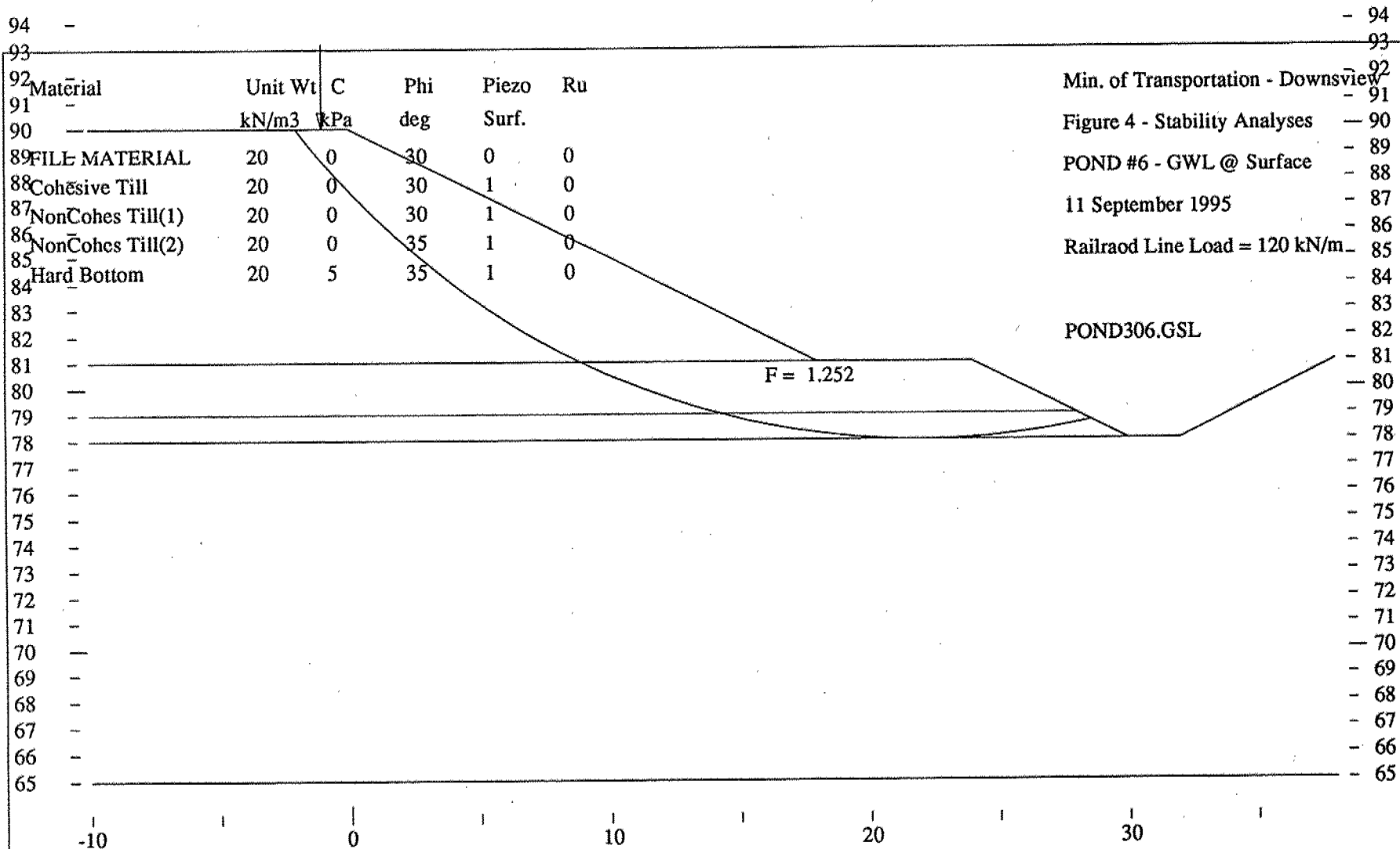


FIG 4

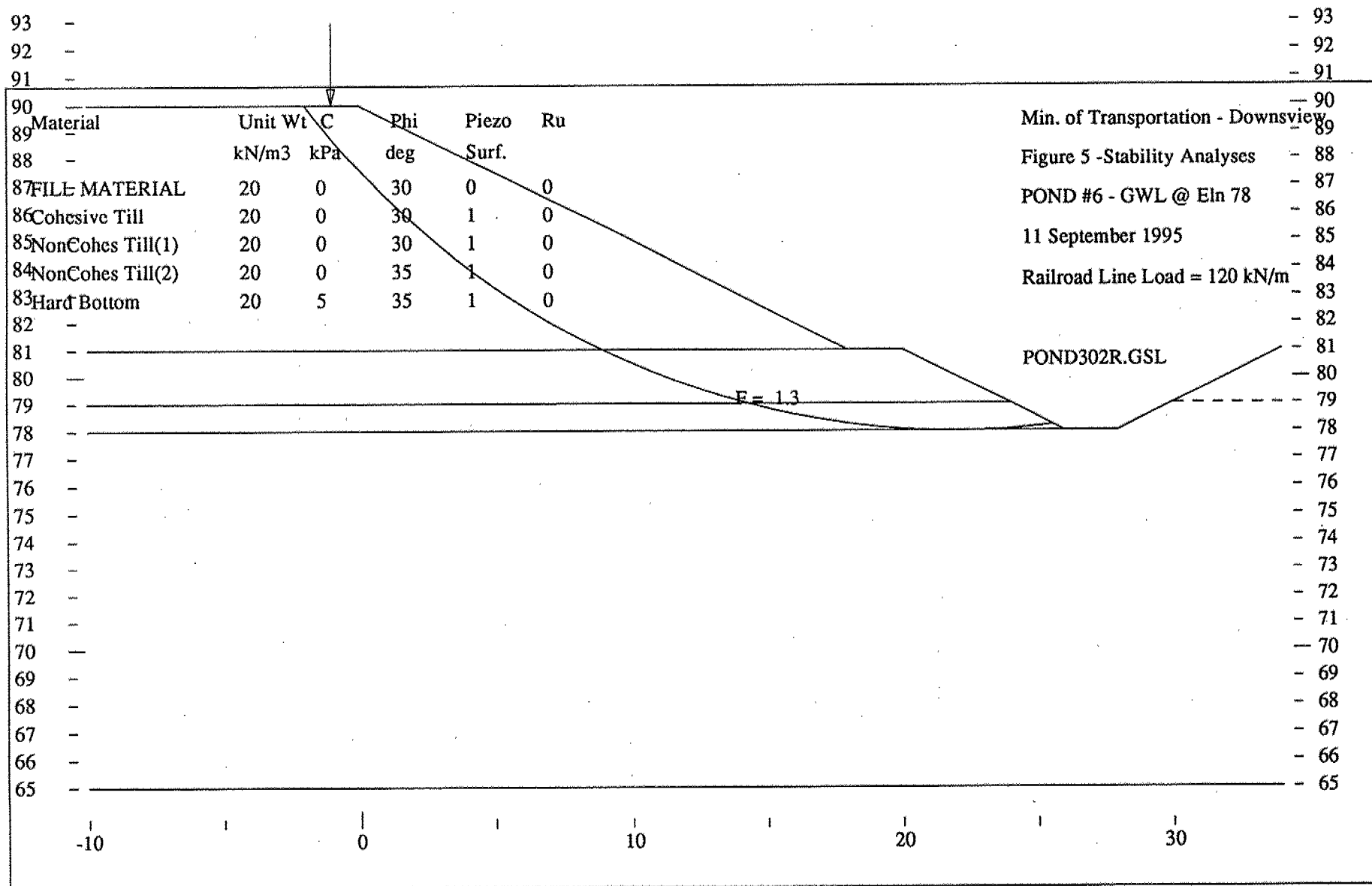


FIG 5

WP 271-87-00
CONT 95-34

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

CONT. 95-34. (WP 271-87-00) LOCATION Stn 29+615, 30.5 RT. (Co-ords: N 4 853 742.5, E 337 010.0) ORIGINATED BY TS
 DIST 6 HWY 401 BOREHOLE TYPE HS Auger COMPILED BY DB
 DATUM Geodetic DATE 95-08-21 CHECKED BY TS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
79.3	Ground Surface												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) random occasional seams of Sand Brown, Stiff		1	SS	10		79					20.0	4 33 44 19
75.7			2	SS	23		78						7 26 56 11
2.8	Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till) Grey Dense Very Dense		3	SS	36		77						3 54 (43)
			4	SS	50		76						
			5	SS	72		75						
			6	SS	50		74						
71.6			7	SS	50		73						0 53 (47)
7.7	Shale Bedrock Grey-Black Weathered, Very Weak						72						
70.0							71						
9.3	End of Borehole												

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

CONT. 95-34. (WP 271-87-00) LOCATION Stn. 29+570, 32.1 RT. (Co-ords: N 4 853 716.5, E 336 973.0) ORIGINATED BY TS
 DIST 6 HWY 401 BOREHOLE TYPE HS Auger COMPILED BY DB
 DATUM Geodetic DATE 95-08-21 CHECKED BY TS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
79.6	Ground Surface																
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	16		79										
78.1	Brown, Very Stiff		2	SS	19		78										
1.5			3	SS	19		77										
	Brown, Compact Grey, Dense to Very Dense		4	SS	35		76										
			5	SS	50		75										
	Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till)		6	SS	90		74										
							73										
71.8	Shale fragments		7	SS	56		72										
7.8	End of Borehole (Auger Refusal)** * GWL Not Stabilized ** Probable Shale Bedrock																

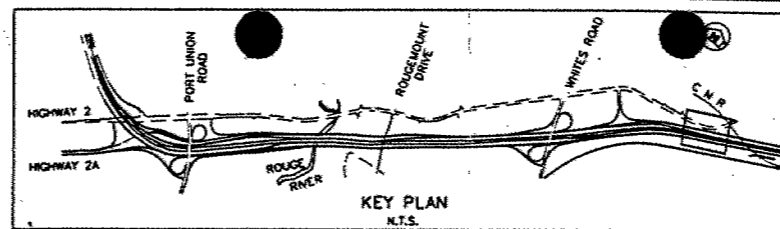
RECORD OF BOREHOLE No 3

1 OF 1

METRIC

CONT. 95-34, (WP 271-87-00) LOCATION Stn. 29+515, 33.6 RT. (Co-ords: N 4 853 685.0, E 338 927.5) ORIGINATED BY TS
DIST 6 HWY 401 BOREHOLE TYPE HS Auger COMPILED BY DB
DATUM Geodetic DATE 95-08-21 CHECKED BY TS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100							10 20 30		
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE										
81.4	Ground Surface																
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Brown, Very Stiff		1	SS	23		81							4 34 41 21			
			2	SS	16		80										
79.1			3	SS	13		79							5 53 (42)			
2.3			4	SS	6		78							13 46 31 10			
	Brown, Loose to Compact Grey, Very Dense		5	SS	71		77										
	Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till) Grey		6	SS	52 /15cm		76										
			7	SS	50 /8cm		75										
			8	SS	50 /8cm		74										
			9	SS	50		73										
72.3																	
8.2	End of Borehole * Shale Bedrock - Grey-Black, Weathered																



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

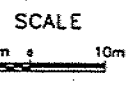
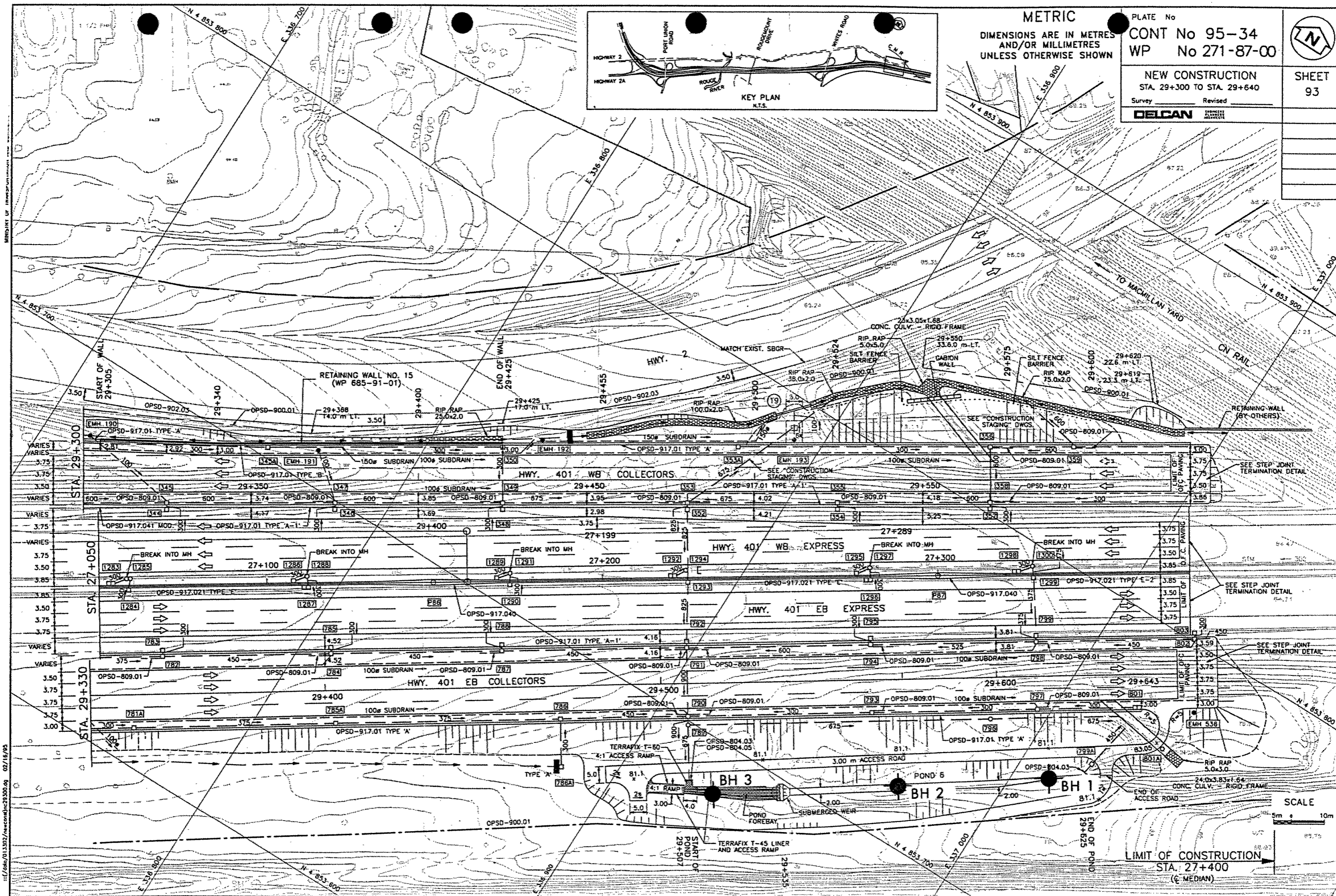
PLATE No
CONT No 95-34
WP No 271-87-00

NEW CONSTRUCTION
STA. 29+300 TO STA. 29+640

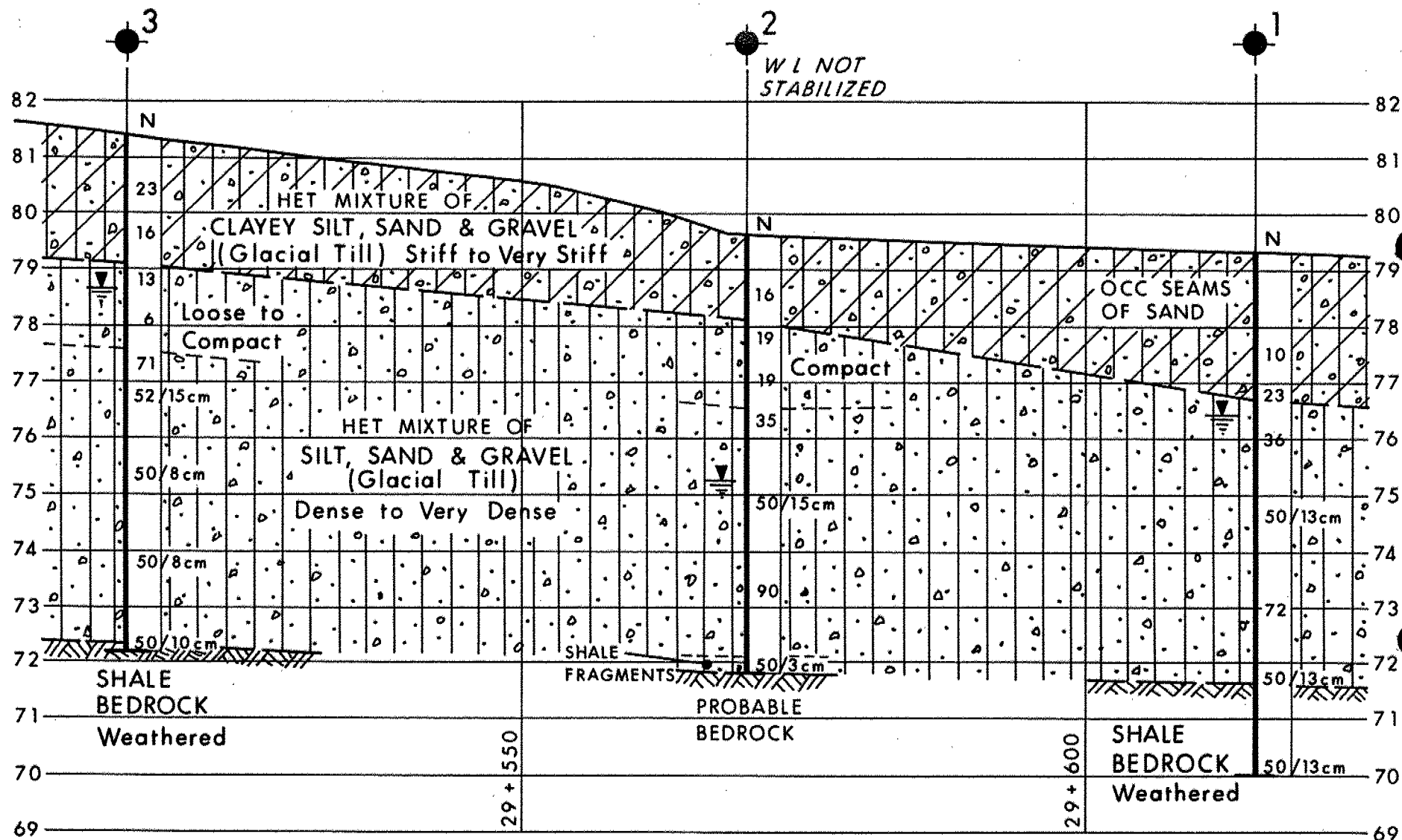
Survey _____ Revised _____

DELCAN

SHEET
93



LIMIT OF CONSTRUCTION
STA. 27+400
(Median)



SUBSOIL STRATIGRAPHICAL SECTION
DETENTION POND 6

SCALE HOR 1:500
VERT 1:100

WP 271-87-00
CONT 95-34
DIST Central Region
Geocres No 30M14-234
Dwg No 9534-A